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Training with the M1 Conduct-of-Fire Trainer (COFT): Instructor/ Operator (I/O) Perspectives

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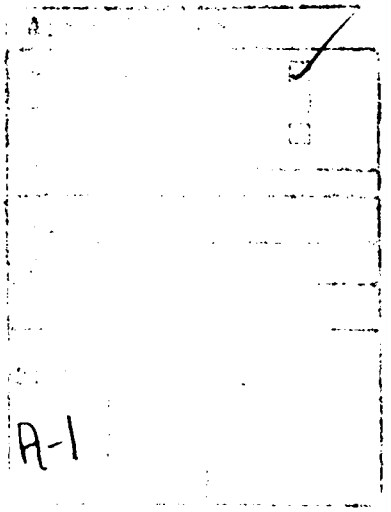

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The military and civilian I-COFT Instructor/Operators (I/O) in the Armor School's pons Department possess a wealth of valuable training information gleaned from years of or training experience. This information should be shared with other I/Os and Armor iners. This research was conducted to aid COFT trainers in the field and the school-se by identifying those I/O training techniques that are particularly effective for ining tank gunnery skills on the COFT. Structured interviews were conducted with the s to discover how to best use the COFT to train tank gunnery skills. Given the increas- costs of live-fire training and the additional need to specify an optimal mix between ulation-based and field training, the interviews also asked the I/Os to discuss the cific value of live-fire training and its relationship to COFT training. The I/Os de-ibed a variety of techniques for training nearly all crew gunnery skills on the COFT. y identified a number of common training problems and offered tips and techniques on to train particular skills. Various approaches for training target (Continued)

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acquisition, tracking, and procedural skills on COFT are discussed, as well as more general COFT training issues, device-specific skills, and features and training enhancements to be found in the Advanced Matrix that is currently under development. The results also identify those aspects of live-fire training not trained adequately on COFT.

Despite the growing technological sophistication of training simulations, it is important to remember that the devices are only a means to an end. The ultimate goal is to ensure that every soldier has the full complement of skills necessary for success on the battlefield. To reach that goal, we must not only continue to work on ways to improve the simulations, but also on ways to improve the training techniques for using them. In the end, the cost-effectiveness of the simulations is largely determined by the training techniques employed by Army trainers.

The research reported here supports this goal by identifying ways in which the high-fidelity Conduct-of-Fire Trainers (COFT) can best be used to train combat gunnery skills. The research was conducted under a Memorandum of Agreement with the Deputy Chief of Staff Training (DCST), U.S. Army Training and Doctrine Command, the Project Manager-Training Devices (PM-TRADE), U.S. Army Materiel Command, and the U.S. Army Armor Center entitled "The Effects of Simulators and Other Resources on Training Readiness."

The research was performed by the U.S. Army Research Institute's Fort Knox Field Unit. The program is designed to support the development of an evolving devices training strategy, a major goal of which is to specify an optimal mix of simulation-based and field tactical and gunnery training. This research was further designed to aid COFT trainers in the field and the schoolhouse by identifying those training techniques that are particularly effective for training tank gunnery skills. In effect, the research tried to document the collective wisdom gained through 5 years' experience with the COFT. The results of the research were briefed to the Director, Weapons Department, U.S. Army Armor School, and were provided to the PM-TRADE Close Combat Training Systems.

TRAINING WITH THE M1 CONDUCT-OF-FIRE TRAINER (COFT): INSTRUCTOR/OPERATOR (I/O) PERSPECTIVES

EXECUTIVE SUMMARY

Requirement:

During a project designed to identify the underlying skill requirements of tank gunnery performance on the Institutional Conduct-of-Fire Trainer (I-COFT), it was recognized that the military and civilian I-COFT Instructor/Operators (I/O) in the Armor School's Weapons Department possessed a wealth of valuable training information that each had gleaned from years of Armor training experience. It was also recognized that it would be useful to collect and share this information with other I/Os and Armor trainers. The present research was then conducted to identify those I/O training techniques that are thought to be particularly effective for training tank gunnery skills on the COFT and to provide information on the specific value of live-fire training and its relationship to COFT training.

Procedure:

A structured interview on COFT training and advanced gunnery techniques was conducted with eight military and eight civilian I/Os from the U.S. Army Armor School's (USAARMS) Weapons Department. The primary focus of the interview was to document how the COFT can best be used to train tank gunnery target acquisition, tracking, and procedural skills. Responses to the interview were taped, paraphrased, and organized.

Findings:

The I/Os described a variety of techniques for training nearly all crew gunnery skills on the COFT. The I/Os identified a number of common training problems along with tips and techniques on how to train particular skills. Various approaches for training target acquisition, tracking, and procedural skills on COFT are discussed, as well as more general COFT training issues, device-specific skills, and features and training enhancements to be found in the Advanced Matrix that is currently under development. The results also identify those aspects of live-fire training which are not trained adequately on COFT.

Utilization of Findings:

The results have been given to the U.S. Army Armor School and are being used to improve COFT I/O training.

TRAINING WITH THE M1 CONDUCT-OF-FIRE TRAINER (COFT): INSTRUCTOR/OPERATOR (I/O) PERSPECTIVES

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TRAINING WITH THE M1 CONDUCT-OF-FIRE TRAINER (COFT): INSTRUCTOR/OPERATOR (I/O) PERSPECTIVES

Introduction

The U.S. Army Research Institute (ARI) Fort Knox Field Unit has a long history of conducting research to enhance Armor training and Armor combat effectiveness. Recently, Graham and Smith (in preparation) completed a project designed to identify the underlying skill requirements of tank gunnery performance on the Institutional Conduct-of-Fire Trainer (I-COFT). The research was conducted as part of an agreement by the U.S. Army Training and Doctrine Command (TRADOC) Deputy Chief of Staff Training (DCST), the Program Manager-Training Devices (PM-TRADE), and the U.S. Army Armor Center (USAARMC).

During the project, the researchers recognized that the military and civilian I-COFT Instructor/Operators (I/O) in the Armor School's Weapons Department possessed a wealth of valuable training information that each had gleaned from years of Armor training experience. It was also recognized that it would be useful to collect and share this information with other I/Os and Armor trainers. As a result, a number of I/Os were interviewed as to how they thought the Conduct-of-Fire Trainers (COFT) could best be used to train tank gunnery skills and to describe any special COFT training techniques that they had developed over the years. This report presents the results of those interviews.

Since their fielding in 1985, the M1 COFTs have become a mainstay of armor gunnery training. The COFTs are high-fidelity tank gunnery simulators in which tank commander (TC) and gunner controls are virtually identical to those in the actual tank. The COFT uses computer-generated imagery to present target scenes in the gunner's primary and auxiliary sights and in the TC's primary sight extension and forward unit periscope. The simulator is used in all phases of crew gunnery training to include basic, cross, transition, and sustainment training.

To meet the specific institutional and unit training needs of active and reserve component forces, the COFT comes in three variants. The Unit-COFT (U-COFT) and Mobile-COFT (M-COFT) are indistinguishable with the exception that the M-COFTs are mounted on trailers for use by reserve component Armor units. The basis of issue for the U-COFT and M-COFT is one per Armor battalion, with each of the battalion's 58 crews receiving approximately five hours of COFT training per month. The third variant, the Institutional-COFT (I-COFT), is located at the U.S. Army Armor School (USAARMS) and includes additional software options that can present individual training on basic tank gunnery knowledge and skills.

One of the outstanding features of the COFT is the training management software, which can be used to monitor and direct training. The instructional subsystem contains a library of preprogrammed exercises organized into two structured training matrices for the TC/Gunner and the TC alone. A key aspect of the instructional subsystem is its performance evaluation capability, which uses a set of rules to select appropriate training exercises. The evaluation subsystem prescribes a computer-recommended progression through the training

matrices based on performance in three dimensions: target acquisition, reticle aim, and system management (General Electric, 1985).

Despite the automated training capabilities of the COFTs, the simulators are fundamentally training tools to be used by trainers, the COFT Instructor/Operators (I/Os). Like other training, COFT training effectiveness is largely determined by the training techniques employed by the trainers. The I/Os are given initial and refresher training on how to train with the COFT, but the quality of COFT training undoubtedly varies between trainers. While there always will be differences in the way different I/Os use the COFT to train, the overall effectiveness of COFT training will be enhanced if I/Os can better be made aware of successful training techniques used by others.

This research was designed to aid COFT trainers in the field and in the schoolhouse by identifying those I/O training techniques that are thought to be particularly effective for training tank gunnery skills on the COFT. The research interviewed experienced I/Os in an attempt to collect their opinions and experiences on how the COFT can best be used to train tank gunnery skills. In effect, the research tried to document the collective wisdom gained through five years experience with the COFT. Given the increasing costs of live-fire training and the additional need to specify an optimal mix between simulation-based and field training, the interviews also asked the I/Os' to discuss the specific value of live-fire training and its relationship to COFT training.

To accomplish these goals, a structured interview on COFT training and advanced gunnery techniques was administered to eight military and eight civilian I/Os from the USAARMS Weapons Department. Each of the I/Os was a tank gunnery instructor. The military instructors were non-commissioned officers (NCOs) with ranks of staff sergeant and sergeant first class. In all cases but one, the civilian instructors were retired Armor NCOs.

Structured Interview Design and Procedures

The structured interview was developed to gather information on how experienced COFT I/Os use the device to train gunnery skills. The primary focus of the interview was on the training of gunner target acquisition, tracking, and procedural skills. Because the I/Os' experience also included training tank commanders (TC) alone and TC/gunner crews on the COFT, their responses covered the gamut of COFT training. Little effort was made to limit the scope of the I/Os' comments. Despite the structure of the interview, the discussions often went in the direction of a particular I/O's experience. A secondary goal was to gain as much information about training gunnery skills on the COFT as possible.

The interview was structured into four sections and is included as Appendix A. The purpose of the first set of questions was to gather information on how the COFT can best be used to train tank gunner skills that lead to improved live-fire performance. The second set addressed COFT-specific skills, i.e., skills that lead to better COFT performance, but are not related tc live-fire performance. This was often understood to be ways of "beating the system." The third set asked about skills required for live-fire or combat that are not trained on the COFT. The fourth set asked about any COFT

training that is believed to result in negative transfer, i.e., training on COFT that leads to poorer live-fire performance.

Following the recurring structure in the four sets of questions, a final question was asked. The I/Os were asked to describe those skills that are trained by live-fire that cannot be adequately trained otherwise. In other words, what specific value is there in live-fire training?

Within each set of questions, the I/Os were first asked about target acquisition skills, followed by tracking skills, and then procedural skills. For each of these skills, for example, target acquisition skills, the I/Os were asked:

1. What do you look for to see if the gunner is adequately demonstrating target acquisition skills, i.e., what behaviors demonstrate this skill or a skill deficiency?

2. How can you best train target acquisition skills on the COFT that transfer to live-fire performance?

   a. What are other approaches that may work as well?

   b. What COFT training approaches do not work?

3. What are the limitations of COFT for training target acquisition skills?

   a. How can you work around these limitations?

4. What do the best gunners do to quickly and accurately acquire targets on the COFT?

   a. Which elements of target acquisition best discriminate good and poor gunners?

   b. How do you train high aptitude/experienced/good performers?

   c. How do you train low aptitude/inexperienced/poor performers?

5. Are there other advanced COFT techniques that you train or performance tips that you give pertaining to target acquisition?

Each interview lasted about 45 minutes. The interviews were taped and later transcribed. The responses have subsequently been paraphrased. Also, the interviews were conducted as an adjunct to a research project by Graham and Smith (in preparation). The purpose of that research was to identify I-COFT gunnery skill requirements and the skills that are trained on COFT. To do so, the I-COFT gunnery performance of tank gunnery novices and masters were videotaped and analyzed. Most of the military I/Os interviewed here also served as tank gunnery masters in that research.

Several caveats are necessary. The remainder of the report is a compilation of what the I/Os said during the interviews and, in a few cases, the results of observations made in the Graham and Smith (in preparation) research. Not everything the I/Os said might be accurate or specifically conform to Army training doctrine. While the I/Os have considerable experience and are truly subject matter experts (SMEs), much of what they said was their opinions. Also, what works for one I/O might not work for another. As a result, some ideas tend to contradict others.

Lastly, while the I/Os that were interviewed are experts, I am not. I have, however, tried to organize the information into meaningful sections and present the information as much as possible in a straight forward manner. While a number of the comments say, "the I/O should" do something or the other, these are actually suggestions as to what might work.

Target Acquisition

Avoiding Tunnel Vision

One of the major problems that new gunners have in the area of target acquisition is tunnel vision. That is, they look right at the reticle and only see those objects that are very near to the reticle. By contrast, experienced gunners learn to use their peripheral vision and, as a result, have a wider field of view (FOV). This was referred to as having "soft eyes" or "blurred vision." The I/O should train the gunner to not focus or fixate too narrowly on the reticle, but to be able to identify any movement or changes in the broader field of view.

Inexperienced gunners tend to fixate on the reticle because it is their frame of reference. One way to tell if a gunner is fixating on the reticle is to watch his scanning pattern. If he is fixating on the reticle, he will tend to stop the reticle right on the sector boundary. Instead, the gunner and TC need to be trained to use the reticle as a scanning guide. To help develop "soft eyes," the gunner and TC should center their view in front of or behind the moving reticle, rather than right on it.

Proper Scanning of Sector

Another major target acquisition problem involves the proper scanning of a crew's sector. The trouble begins with new gunners not being able to recognize and/or remember their center sector and left and right boundaries. It was widely agreed that most soldiers cannot learn proper scanning techniques on their own, but need to be specifically trained scanning techniques by the I/O. One way the I/O can help is to point out the sector boundaries at the beginning of each exercise and to tell the crews when they are consistently going outside of sector. The synthetic TC in the I-COFT software keeps the gunner in his sector by saying, "Gunner, stay in your sector," and then by slewing the gun back into sector.

Scanning Beyond Sector Boundaries

Another problem that some gunners have is in scanning right or left until the reticle is all the way to the sector boundary. The result of this is that the gunner is scanning too large of an area. The gunner should scan left until the left edge of his field of view is at the left sector boundary and then scan right until the right edge of his FOV is at the right sector boundary.

Many crews do not understand that the gunner must scan right and left only to make up an extra 11 degrees. On the COFT, the TC's FOV and sector of responsibility on the COFT is 32 degrees. The 3X Gunner's Primary Sight (GPS) FOV is 21 degrees. The gunner must therefore only scan 5.5 degrees to the left and right of center to observe the entire sector. Scanning too far slows down acquisition times because it takes extra time to go from the far right to the far left, and more often the gunner will be at one side of the sector when the target appears at the other side. Also, excessive movement of the turret on the actual tank increases the likelihood of injury.

Target Search Techniques

Proper scanning techniques should be taught first. Once the crews have, however, learned to know their sector limits and to scan quickly, they must be trained techniques for visually searching their sector for targets. The I/Os varied in how they trained the gunners to search their sectors while scanning. Some I/Os trained the gunners to search near to far, while others trained far to near, or left to right. Whatever method the I/O prefers, he should train the gunner to be consistent and to use the same pattern every time.

For crew exercises with the TC and gunner, it was generally agreed that the TC should search near while the gunner searches far, as the gunner has a magnified view in the GPS and the TC does not. The alternative is to split the sector into separate right and left areas of responsibility for the TC and gunner.

The TC should be trained as quickly as possible to search and identify targets while looking through the forward unity periscope (FUP). As in the actual tank, there is a tendency for TCs to want to search for targets using the GPS Extension. While looking through the FUP, the TC also should be trained to slew the main gun to where the gunner can find the target in 3X magnification. Each of these search strategies apply equally well to the real world as to the COFT.

As in the field, the crews should be trained to search for targets primarily in logical locations. They should watch terrain features, folds in the earth, man-made features, as well as watch for target signatures and movement. Gunners should scan far ridge lines, while the TC should look close in. Squads of troops, for example, are likely to be found on the front of hill masses, where the troops would have to be to engage tanks. In general, the crews should be searching for anything that changes. Regarding the placement of COFT targets, the I/Os believed that the location of the targets were realistic.

By using "soft eyes" and being aware of terrain features, experienced crews become very good at detecting anything that changes or is unusual. As a result, experienced crews generally do not have problems with target acquisition on COFT. Also, the crews that are best in target acquisition are those that are disciplined in scanning and in searching their sector.

COFT Flash Cues

The COFT cues the crew to the appearance of the target by presenting a flash. New crews see the flash, but often do not react to it. The I/O should explain what the flashes represent. In some cases, a small muzzle flash gives the location of the target, while in other cases a larger flash simply indicates that a target has appeared. Crews with moderate experience learn to use the information in the flash, but have trouble finding the target after the flash has disappeared.

For crews having trouble with target acquisition, it is helpful to take the crews out of the COFT and let them watch an exercise on the I/O's screen. From there the I/O can show them the sector boundaries, muzzle flash, and what the targets look like in 3X and 10X. When they go back into the COFT, they usually do much better.

Scanning Speed

Experienced crews scan their sector at a moderate rate, i.e., fast, but not so fast so as to cause the scene to blur. New gunners almost always are slow in their scanning, in part because they are not confident in what they are looking for. As the gunner becomes more proficient, the I/O should encourage him to scan at a moderate rate.

Switching to 10X Magnification

I/Os should spend more time specifically instructing trainees when to flip the GPS magnification switch from 3X to 10X. They should be trained to switch not just when they have visual contact with the target in 3X, but when the target is within approximately 15 mils of the reticle. Trainees tend to be too far left or right from the target when they switch from the 3X to 10X. As a result, the target is not in the 10X FOV when they switch and they lose the target. A gunner who can not properly switch from 3X to 10X will increase his Identification (ID) time from 3-5 seconds. The inability to properly switch will keep him from reaching the higher skill levels of basic gunnery.

Experienced gunners should also have the ability to switch back and forth quickly between 3X and 10X. They should switch from 3X to 10X if they suspect something is a potential target. If it is not a target, they should quickly switch back to 3X and continue scanning. The ability to switch back and forth rapidly is less critical on the COFT than in combat gunnery where crews are required to search for targets for long unknown lengths of time. Switching back and forth does not occur that frequently on the COFT because experienced crews are generally good at acquiring targets.

Use of Thermal Imaging System

Armor doctrine is changing to where tank crews are now using their night sight, the Thermal Imaging System (TIS), to search for targets both at night and in the day. As in the actual tank, using the TIS to find targets on the COFT is easier than using the day sight. It is a mistake, however, to allow crews to only use the TIS. The use of the daylight sight may be required if the TIS fails during combat. That it is more difficult to find targets with the daylight channel means that more training is required in daylight.

Weaknesses in COFT Target Acquisition Training

Training target acquisition skills on the COFT is one of the weaker parts of COFT training. As just discussed, the COFT can be used to train proper scanning and search techniques. The crews are, nevertheless, scanning and searching for computer-generated, cartoon-like target graphics. The COFT targets have considerably different visual characteristics than either pop-up silhouettes on the range or real enemy targets in the desert. COFT training also leads to the development of some target acquisition skills that are specific to the COFT; for example, all COFT targets are the same color. Also, with experience, a TC can develop the unrealistic skill of being able to distinguish between tank and armored personnel carrier targets at 2000 meters while looking through the FUP.

Furthermore, experienced crews become very good at target acquisition on the COFT. Many fewer crews are good at target acquisition in the field, as is seen in Tank Table VIII or even in the Canadian Army Trophy (CAT) competition. This means that being good at target acquisition on the COFT does not necessarily mean being good at target acquisition in the field.

Anticipated Effects of Improved Computer-Generated Images

For some time there has been discussion about upgrading the COFT's computer-generated imaging (CGI) system to reduce the cartoon-like nature of the COFT graphics. While the cost of CGI has dropped in recent years, CGI remains one of the highest cost drivers in simulation systems. There is also considerable uncertainty as to what levels of fidelity, including visual fidelity, are required to train particular tasks. When asked about the likely effect of improved graphics on COFT training effectiveness, the I/Os gave mixed opinions. Several I/Os thought that improved graphics would improve training of target acquisition skills, for example, in distinguishing between friend or foe. Improved training in this area is needed as the history of war and more recently performance at the National Training Center (NTC) have shown that fratricide, i.e., shooting your own or allied vehicles, is a real problem. Whether improved graphics will help or not is less clear. It may be that the crews would only learn to better discriminate COFT-specific cues as to what is a friend or foe.

Other I/Os did not think that improved graphics would help training in the area of target acquisition or in any other area. For target acquisition, the COFT primarily trains the crews to scan and search sectors of responsibilities thoroughly and rapidly. Improved graphics probably would not help

train these skills any better than the current graphics. It was also thought that once the crew is fired upon, the crew forgets about the cartoon-like scenery anyway. At that point it is either kill the target, or be killed. To kill the target, the crew must rapidly and accurately execute a coordinated target engagement sequence. Being able to execute that sequence is largely independent of the quality of the graphics.

Target Acquisition Training in the Field

While training target acquisition on the COFT is limited, it is also limited in the field. Little or no target acquisition can occur in the motor pool or in the local training area. You can train target acquisition on a live-fire range, but at all potential target locations there is a "v" cut in the ground from short rounds. Almost all crews know this and, as a result, they learn not to scan properly. Instead, they scan from "v" to "v," until they see a flash of light reflecting off a panel. Another limitation of field training is that the majority of the targets are unrealistically close. Most target acquisition training in the field occurs at ranges of 800 - 1000 meters. There are very few ranges in which targets can be presented at 2000 meters.

Quality Target Acquisition Training on the COFT

As with training all skills on the COFT, the quality of training is determined by the I/O. This point is especially true for target acquisition training as the level of visual fidelity of the COFT is not as high as it is in other areas, e.g., location and feel of the switches. For crews having difficulty, there is a temptation for the I/O to cue the location of the target. Once the I/O starts to cue a crew, for example, even by saying "Action right or left," the quality of the COFT training and the motivation of the crew to learn target acquisition skills are greatly diminished.

You can use the COFT to train the gunner and TC to scan properly and to apply consistent realistic search strategies. The COFT can also be used to train the crews to look for the same types of cues or target indicators that they will find in the field. These include muzzle flash, smoke, target movement, and disparity in color. The key to quality training is to motivate the I/O or the instructor in the field to focus on these particular aspects of target acquisition and to use sound training techniques in training these skills.

Tracking

The ability to make fast, smooth, accurate tracks is most critical to successful gunnery performance. Graham and Smith (in preparation) found that tracking skills were the best predictor of the speed and accuracy for killing stationary, as well as, moving targets. Tracking and killing moving targets is also one of the most difficult aspects of tank gunnery. Regarding the training of the tracking skills on the COFT, the I/Os said that crews needed to understand how the fire control system operated and be given large amounts of hands-on practice.

Understanding the Fire Control System

The I/Os suggested that frequently not enough time was spent explaining how the M1 fire control system works including the purpose of each component in the system. Instead the crews are too often only given feedback on the outcome of their performance, e.g., they killed seven of ten targets. To fully take advantage of the tank's computerized fire control system, the gunner needs to understand why he is being trained to do certain things, i.e., to come up smoothly on a moving target from behind, to track it for 1.5 seconds, to watch the reticle displace, to continue to keep the reticle on the target and track smoothly, and then to pull the trigger. It was also suggested that the I/O should explain and demonstrate what happens when procedures are performed incorrectly, e.g., being too jerky or tracking too fast.

Many gunners have trouble maintaining a smooth track as the reticle displaces, i.e., when lead is induced into the system. When the reticle jumps, some gunners try to compensate for the movement by jerking the control handles. The I/O should explain to those soldiers that the reticle displacement is the way the stabilization system works. Also, some gunners do not understand that when the tank is moving, the reticle has a small up and down motion; this is like it would be in the real tank. The I/O should tell the gunner to ignore the vertical movement and specifically not to try to compensate for it, as the tank stabilization system will null out the vertical movement.

Tracking with the Wrists

The I/Os should train the gunners to keep their elbows tucked into their sides when tracking and to track with their wrists. Some gunners try to track by moving their arms, like they are turning the steering wheel of a car. This will almost always lead to erratic tracking and overcompensation.

For tracking with the TC's override, the TC can use his left arm as a brace by gripping his right arm at the wrist. He can then control the movement of the TC's override by tightening the muscles in his chest. To track to the left, slowly tighten the muscles, to track to the right slowly relax the muscles. Bracing with the left arm also reduces the risk of injury by keeping the arm out of the way.

Training Tracking Skills

For novice gunners, the focus of the training should be on tracking accuracy rather than speed. The gunner should be told to concentrate on two things: (1) getting the reticle on the moving target and (2) tracking at the same speed as the moving target. The training should focus on learning how to track, not necessarily on trying to kill the target. In general, new gunners are slow in getting to the target and then have jerky tracking during the final lay.

Some of the I/Os suggested that the instructions be kept as simple as possible at first. For example, one I/O focuses on the following steps: (1) always come up on the target from behind, (2) lase as soon as the aiming dot

is surrounded by the target, (3) if there is a good lase, match the speed of the turret to the speed of the target, and (4) if there is a steady sight picture, pull the trigger. The I/O believes that the novice gunner is given too many numbers to remember, for example, tracking for 1.5 seconds before lasing and then tracking another 1.5 seconds before firing.

Also, while the technical manual (TM) states that you must track a moving target for 1.5 seconds before lasing, it is not really necessary to track that long. What is important is that the reticle is moving the same speed as the target when you lase and thereby induce lead. It may, nevertheless, be worthwhile to tell the novice gunner that he needs to track 1.5 seconds to keep him from rushing.

Other I/Os said that as the gunner becomes marginally proficient, the I/O should emphasize speed, rather than focusing on getting kills in the "sweet spot" of the target, i.e., $\leq$.67 mils from center mass. If you emphasize killing targets quickly, often the crews will become more accurate on their own over time. If a sustainment crew is very fast, e.g., with kill times less than 12 seconds, you should switch the emphasis back to accuracy.

Proper Elevation First

When tracking a moving target, the gunner should first align the reticle to the proper elevation. Typically this is done by coming up from behind the moving target. To do so, the gunner can use the horizontal line on the reticle to split the target in half as he comes from behind the target. This same strategy should also be applied to stationary targets, as Graham and Smith (in preparation) found that the most misses on stationary targets are due to aiming too high or too low. This recommendation is in contrast to the "G" pattern approach in which the last movement is up.

Dumping Lead

Crews often do not understand how the stabilization system works and the necessity for "dumping" lead. Lead is induced into the system whenever the laser range finder button is depressed or when the TC depresses the manual range battle sight button. As lead is entered into the system, the entire sight picture, including the reticle, displaces in the direction opposite of the target movement. The faster the track, the greater the displacement. To dump or remove the lead from the system, the gunner must momentarily release the palm switches on his power control handles.

The gunner should be trained so he automatically dumps the lead after each engagement. When the gunner is getting on the target, he should never have any lead in the system. Gunners should also be trained to dump the lead whenever a moving target changes direction. What will sometimes happen is that a gunner will track and lase, and then make some dramatic adjustment or simply jerk the power control handles. The radical movement of the controls causes the ballistic computer to make dramatic adjustments to the tracking rate. The result is that too much lead gets into the system and the reticle looks like it is being pulled by a stretched rubber band.

When too much lead gets into the system, the gunner should dump the lead and relase. Instead, some gunners have a tendency to want to compensate for the added lead by moving the handles. Good gunners, by contrast, recognize when they have lead in the system and can quickly dump the lead and relase. Novice gunners should be trained to recognize from the sight picture when lead is in the system. Too much lead is generally characterized by the reticle being jittery and off center.

Ambushing

Some gunners try to ambush moving targets by placing the reticle in front of the target and waiting for the moving target to catch up to the reticle. This is a bad practice which usually results in missing the target. Ambushing occurs quite a bit in sustainment crews that have had experience on other tanks. One Station Unit Training (OSUT) and Armor Officer Basic (AOB) gunners are trained not to ambush from the beginning. As a result, they almost never try to ambush moving targets. Like all COFT training, it is the responsibility of the I/O to watch for ambushing and to stop the gunners from doing it.

COFT Control Handles

The power control handles on the COFT are more sensitive than those on the actual tank. It is therefore easier to make a smooth track on the actual tank with its hydraulically driven system. It was often said that the more sensitive COFT controls inadvertently made the COFT training even more valuable. If you can track with the touchy COFT controls, you can certainly track with the smoother tank controls. Also, it was noted that like actual tanks, the sensitivity and feel of the controls varied somewhat between COFTs.

Aiming Point Indicator

The I-COFT has several special instructional features which can be used by the I/O. One is the Aiming Point Indicator which places a red dot on the center of the target; the dot disappears when the gunner has a good track. The aiming point designator not only shows the gunner the center of the target, but also provides immediate feedback when he has a good track. Several of the I/Os said that showing the novice gunner what a good track looks like with the aiming point indicator is more effective than simply explaining how to track. Another instructional feature, the Target Designator, aids target acquisition by placing a box around the target.

Jerking the Control Handles

Some gunners have a tendency to jerk the power control handles as they say, "on the way," or as they pull the trigger. The I/O should watch his monitor carefully to note if the gunner is doing this.

Targets Changing Range

Some targets are missed because the gunner waits too long after he has lased to fire. In some cases the range of the target changes sufficiently

enough to cause a miss. This is more true when firing HEAT rounds than SABOT rounds, in that SABOT rounds have a relatively flat trajectory. For targets moving directly towards the gunner, some I/Os instructed the gunner to aim slightly on the low side of center mass. If a target, for example, was moving towards you at 30 kilometers per hour, its range would decrease approximately 40 meters in five seconds.

Amount of Tracking Training

The amount of training required for a gunner to become proficient at tracking varies greatly. Some soldiers have good hand-eye coordination and pick up tracking quickly. Others require a considerably longer time. The I/Os reported that they sometimes had gunners or crews who they thought would never be able to track, but surprisingly, all of a sudden their tracking was right on the target. Several I/Os thought that experience with video games helped tracking performance. On the other hand, it is not clear whether video games train hand-eye coordination or soldiers with good hand-eye coordination tend to play video games. It was widely stated that learning to be a good tracker takes a long time and a lot of practice.

The estimates of how long it takes to train up a novice varied. One I/O estimated that it would normally take 3-5 weeks of training with 2-3 hours a day to train basic gunnery skills. He said, however, that a high aptitude soldier could be trained up in 5 days. He noted that these skills are not easily sustained without continual practice. Another I/O thought that he could train a high aptitude soldier to track smoothly in 2-4 hours. The I/Os also said that officers from the AOB course tend to pick up the target engagement skills a little faster than the recruits in Armor OSUT.

As reflected in these estimates, the I/Os thought that hand-eye coordination determined to a large extent how quickly a gunner or crew could be trained. Most of the I/Os also went on to make the same somewhat contradictory points. They said that they had each trained gunners who were so uncoordinated that they should not be tankers. On the other hand, they each said that with enough training, even the worst gunners could be trained to do the job adequately.

Regarding the amount of training required, the discussion often included sports analogies, e.g., the time required to be a good golfer. Being a good gunner or TC requires the development of speed and accuracy skills necessary to perform a fairly complex task. While the training constraints were well understood, it was generally believed that five hours of training per month on the COFT was not enough training time to sustain high levels of performance. Regarding the golf analogy, a world class golfer trains perhaps 40 times that amount and an average club player gets about 8 times that much training.

One of the military I/Os interviewed who had demonstrated excellent gunnery performance in the Graham and Smith (in preparation) research said that when he first came to the Weapons Department he trained 3 hours a day on the COFT. He now tries to spend an hour a day on the simulator to keep his skills honed.

Switchology

Switching without Looking

One of the most important things that a gunner learns on the COFT is the location of all fire control system switches. He should be able to grab each of them quickly without having to take his head out of the sight. This skill takes a while to develop. Until the gunner can find all of the switches that may be used during a gunnery engagement without looking, the TC or I/O should have him practice finding the switches during the downtime between the COFT exercises. As the gunner becomes more proficient, he also becomes more confident which helps that much more. After some time, gunners get to where they can subconsciously find the switches. But to get to that point, they must concentrate on the location of the switches. That is why it is all the more useful to train finding the switches without looking in between COFT exercises.

Using Two Hands

When scanning for targets, the gunner should use his left hand to manipulate the power control handle, while simultaneously using his right hand to switch the magnification lever and the gun and ammo select switches. To increase speed, the gunner should use the two finger method. While he scans with his left hand, he should have his right thumb on the GPS magnification lever and his right index finger on the gun select switch. When the target appears, he should scan over to the target with his left hand, switch the magnification lever with his right thumb and gun select switch with his right finger. After switching, he should move his right hand over to the power control handle and track with both hands during the final lay, lase, and trigger pull.

Common Procedural Errors

The I/Os said that the most common procedural errors were:

- the TC not turning control over to the gunner soon enough.
- the gunner forgetting to arm the main gun
- the gunner not looking in the gunner's auxiliary sight (GAS) to determine when the main gun has cleared the berm
- the gunner not telling the driver to stop after clearing the berm
- the gunner firing before the TC says fire

The I/O should pay particular attention to these errors and give the crews additional training as appropriate.

Another set of procedural errors involves confusing the GPS switches with the TIS switches. Novice gunners sometimes will switch the GPS magnification lever while using the thermal sight. To help alleviate this

problem, the I/O should frequently remind the gunner that all GPS switches are on the left while all TIS controls are on the right.

As discussed earlier in the target acquisition section, gunners have difficulty learning when to switch from 3X to 10X. The I/O should explain clearly and precisely when to switch to 10X in both day and thermal sights. The tendency is for gunners to switch too quickly and as a result lose the target in their field of view.

Most of the procedural errors can be detected by the I/O by watching his monitor. Information on the screen, for example, indicates if and when the weapon is armed and who has control of the turret. It is the I/O's responsibility to monitor this information and to give appropriate feedback to the crews. If the same procedural error occurs on several successive engagements, the I/O should stop the exercise and tell the crew what they are doing wrong, as opposed to waiting until the end of the exercise. In general, immediate feedback is more effective than delayed feedback.

Going to the GAS

On defensive engagements, the gunner must look into the GAS and tell the driver to stop as the GAS and gun clear the berm. Because the COFT software automatically stops after the tank has moved out, it is the responsibility of the I/O to monitor the accuracy of the gunner telling the driver when to stop. Frequently new gunners look into the GAS and say, "driver stop," but their timing is off, i.e., they are either too early or late. The timing errors are probably due to the gunners not understanding what they are supposed to be doing or not clearly knowing what they are looking for.

One I/O suggested that a good way of teaching the gunner the purpose of going to the GAS is by showing him a picture of an M1 tank. To demonstrate what a defensive position looks like, the I/O puts a sheet of paper over the picture to just below the ballistic doors on the doghouse. He then shows the gunner what happens when the tank moves out into a hull-down position by lowering the paper to below the GAS, indicating that the tank has cleared the berm.

Fire Control System Symbology

New gunners have difficulty learning to use the symbology in the GPS sight. Trainees are given classroom instruction on the meaning of the fire control system symbology, e.g., multiple return bar, flashing zeros, and the ready-to-fire symbol. Unless, however, the symbology information is reinforced by the I/Os, the information tends to be ignored and forgotten by new gunners. Because so much effort and attention is required to acquire, track, lase, and fire at a target, many gunners do not see this information, even though it is clearly displayed in the GPS view. As a result, they try to fire when they do not have a ready-to-fire symbol or fire when the range display shows flashing zeros. It was widely agreed that I/Os should place a greater emphasis on symbology and switchology.

The I/O should frequently remind the crews what the symbols mean. The ready-to-fire symbol, for example, indicates that (1) a ballistic solution has been calculated by the computer, (2) that the GPS reticle is in the position specified by the ballistic solution, and (3) that either the TC or gunner has the palm switches depressed.

When the multiple return bar appears above the range display, the TC should check to see if the range that is showing is likely correct, or have the gunner relase. The I-COFT synthetic TC software will always say "relase" when an incorrect range is in the system, with or without a multiple return bar.

Flashing zeros generally occur in the range display when all returns are either less than 200 meters or more than 8000 meters.

Crew Coordination

One of the primary goals of COFT training is to develop coordination between the TC/gunner pairs. The TC and gunner should work to develop a rhythm between them, so that no time is wasted. Crew coordination starts by ensuring that only one person talks on the intercom at a time. Actions and communications should be short and precise, if the target is to be engaged in a minimum amount of time.

All of the switchology should be performed the same way each time. It does not matter, for example, if the gunner arms the weapon first or switches to 10X. What is important is that each crew member and then the entire crew develop a routine that can be performed automatically. As mentioned earlier a big part of this includes knowing where the switches are located without having to look.

Preparing Crew Stations for Operation

The I/O should spend more time training and emphasizing the adjustment of the seat and browpad, the focus of the GPS and GAS eyepieces, and the adjustment of the polarity and sensitivity of the TIS.

COFT-Specific Skills

Device-Specific Skills

Before presenting the I/O's responses to questions about COFT-specific skills and negative training, it is useful to discuss the concepts. Generally speaking, the training effectiveness of simulators is largely determined by two factors. The first concerns the similarity of the actions performed on the simulator to the actions performed on the actual equipment. The second concerns the similarity of cues presented by the simulator to those presented in the real world. That is, do the auditory, visual, tactile, and other cues presented by the simulator elicit the same response as similar cues presented in the field? If there is a high similarity between responses and cues in the simulator to those in the field, then you can expect positive training

transfer. Another requirement for training transfer is that practice on the device leads to improvement on the device.

One pervasive threat to training device effectiveness is the development of device-specific skills. Device-specific skills involve learning the idiosyncrasies of the simulator system, e.g., learning to watch for certain cues or knowing that events happen in a particular order. In other words, learning device-specific skills is learning ways of beating the system. Success in playing video games, for example, is largely the result of learning how the games work and being able to take advantage of the specific patterns in the game. Device-specific skills lower the training effectiveness of a device, as the simulator is providing cues for responses that are unlike those in the field.

Given human ingenuity and the will to win, it is likely that all simulators train some device-specific skills. The effectiveness of a training device will depend on whether the development of device-specific skills is small relative to the development of skills which transfer to performance on the actual equipment. Also, it is important that device-specific skills do not result in negative training. Negative training occurs when training on the device directly relates to poorer performance in the field. Knowing, for example, that targets are always presented from left to right on a simulator would help performance on that simulator. This knowledge would most likely be device-specific as that knowledge would not help performance in the field. If in the field, however, the soldier only looked at the beginning of an engagement for targets on the left, he would have been negatively trained.

As can be seen in the following paragraphs, there are several areas in which the I/Os identified COFT-specific skills or ways of beating the COFT system. For the most part, however, the I/Os believed that if the I/O did a diligent job, there would be few differences between the requirements of COFT and the requirements of actual tank gunnery.

Acquiring Targets

Knowing the location of the targets was the device-specific skill cited most often by the I/Os. If a crew receives a lot of training on the COFT in a short period of time, they begin to learn where the targets are in the database. Generally the targets appear in the same places across exercises. Some soldiers remember where all of the targets come up, and as a result, receive very little training in target acquisition. To prevent this, a crew should not receive more than 2 hours training on the COFT per day.

Regarding target acquisition, experienced crews know that there are 30 seconds from the time the unfreeze button is depressed until the first target appears; this knowledge allows the gunner to anticipate the target. Subsequent targets appear 20-25 seconds later. Also, crews with COFT experience tend not to scan until the target they had just killed disappears. Only then do they begin concentrating on finding the next target.

Another way of beating the system in the area of target acquisition is when the I/O cues the crew as to the location of the target, for example, by

saying "Action left or right." By looking at the ID times on the performance reports, it is generally possible to tell whether the I/O is helping the crew find the target. If the ID times are very short, the I/O might be helping the crew.

If the crew remembers or is told where the target is located, there are two negative fall-outs. First, as mentioned, the crew is not receiving training in the area of target acquisition. Second, the COFT performance standards and evaluation criteria are severely compromised. The COFT standards are defined, for example, such that if a crew can kill a single target in less than 15 seconds, they can get an advanced recommendation in Reticle Aim. This standard is based on the assumption that it will take a good crew nearly 5 seconds to search and acquire the target. If the crew knows where the target will appear, for example from behind a particular barn, they can acquire and be on the target in less than a second. It then becomes relatively easy to kill the target in 15 seconds.

Taking Short Cuts

Like on the actual tank, it is possible to short-cut certain procedures and safety precautions. For example, the TC may not give a complete fire command. Regarding safety, the TC may not put the kneeguard down or may sit with his feet on the breech. It is the responsibility of the I/O to make the crews comply with the safety rules and procedures, following the Army's "Train as you'll fight" directive.

On defensive engagements from a stationary tank, the gunner must take his head out of the GPS and look through the GAS to ensure that the gun tube has cleared the berm. The COFT uses photoelectric sensors to detect which sight the gunner is looking into. The gunner's view, either through the GPS or GAS, is then shown on the I/O's monitor. Some gunners try to deceive the I/O by keeping their head in the GPS and triggering the GAS photoelectric sensor with their hand. It then appears as if the gunner is looking through the GAS. It is possible, however, for the I/O to tell the difference between actual head movement and the gunner using his hand. Again the I/O should make the gunner follow the full procedure.

Gunners will also try to keep the gun armed between engagements. Some unit standing operating procedures (SOPs) may state that the weapon should be left armed, and it was believed that many crews leave the weapon armed during Tank Table VIII. For safety and security reasons, Armor School doctrine states that the gun select switch should be placed in a trigger safe position after each engagement. All USAARMS COFT training requires the gunner to switch to trigger safe between engagements.

Idiosyncrasies

In the I-COFT evaluation of the normal mode reticle drift, if the trainee has a little drift in the reticle and finishes the exercise in under 15 minutes, he will get a NO GO for the entire exercise. But if he has a little drift and takes more than 15 minutes, he will get a GO.

While not really a COFT-specific skill, the COFT gives a higher reticle aim score for hitting the target in the "sweet spot," i.e., within .67 mils of center mass. That the gunner or crew does not receive the top score, even though they are killing all of the targets within the time standard, is difficult for some trainees to understand. The I/O should take the time to explain the COFT scoring procedures.

Negative Training

Only one possibility of negative training was identified. The COFT will not let the gunner lase to the target while the tank is in a turret defilade position. Unlike the actual tank and unlike the scoring in Tank Table VIII, the COFT tank must move up into a hull down position before it can lase. The result is that the crews come up as quickly as possible on the COFT to get a good ID and Kill time. As reflected in the Tank Table VIII scoring, the tank should remain in a defilade position as long as possible.

General Issues

COFT Training

That COFT training is largely automated is a mixed blessing. As stated throughout the report, it is widely held that the quality of the training is primarily determined by the actions and feedback of the I/O. There are, however, several potential pitfalls in the Army training system that can degrade the quality of COFT training. Because the COFT has a training management system that, in a sense, automatically monitors and directs training, there is sometimes a tendency for commanders not to monitor COFT training all that closely. Instead, commanders assume that training is proceeding as planned. Regarding this, one I/O quoted GEN Bruce C. Clarke who said, "If the boss don't check, the troops don't do it." He felt that the troops were sometimes compromising the system because it is more important to progress high into the matrix than it is to receive quality training.

The COFT is capable of training most if not all of the skills necessary for successful tank gunnery, but what makes it work is the integrity of the I/O and the NCO or commander who insist that no one takes any short cuts. Unless this happens, COFT training is only another mark on the wall which must be met. If the COFT training is compromised, being at a particular reticle aim level means nothing. It is how a crew got there that is important. Similarly, there is some talk around the Armor School and in the field that "COFT is broke." By this it is meant that the existing training matrices and controls do not result in sufficient quality training. The majority of the I/Os thought that this was not the case, but that the system was not being used to it's full training potential.

Unit Training Plans

Good units allocate gunnery training time across 12 months, with COFT training systematically integrated with hands-on field training. There are, however, tremendous pressures on the units to meet other obligations for most of the year. For ten months of the year, gunnery training is often deempha-

sized. The unit must then cram gunnery training into two months. The problem is further complicated by directives to use the COFT for so many hours per month and requirements that crews must be at a particular matrix position before they are eligible to fire the Combat Tables. These requirements pressure units into training around the clock and doing everything possible to get the crews advanced through the matrix. Training around the clock just prior to gunnery is shooting the system in the foot. At 0300 hours, neither the crew nor the I/O cares much about skill development.

While having a good systematic training program may be the key, it is often very difficult for units to find time to schedule COFT training across 12 months. Also, units and their commanders often lack the technical expertise to adequately monitor the COFT training and the training records. For example, one division commander established a policy which required every crew to train on COFT for a minimum of five hours a month. While that was a good goal, the five hours were measured with the elapsed time meter on the I/O's station. Time on the system does not translate into amount of quality training.

COFT Matrix Requirements for Live-Fire

Currently there is a requirement for crews to be at matrix position 33522 (into Reticle Aim Group 5) before firing Tank Table VIII. The rationale for the matrix requirement is that soldiers should not fire costly live ammunition until they have demonstrated on COFT that they have the necessary skills to pass Table VIII. The bottom line is that failing Tank Table VIII costs money. The matrix requirement received mixed comments from the I/Os. On the positive side, it was strongly held that COFT training directly leads to successful live-fire performance. It was often noted that COFT is harder to shoot than a real tank, so if the gunner is good on COFT, he should have no problem in the field. Another plus for the requirement is that it encourages crews to take the COFT training seriously. The I/Os said that the main reason some crews have trouble progressing in the matrix is that do not take the training seriously enough.

The downside of the matrix requirement is that it focuses the COFT training on advancing in the matrix, rather than on developing gunnery skills through quality training. In effect, the COFT becomes less of a gunnery trainer, and more of another standard that must be met. If a battalion commander tells a company commander he wants 12 crews certified in 30 days, the company commander will do whatever is necessary to certify those crews, even if it might mean compromising the integrity of the training. Furthermore, commanders can not afford to admit that their crews are not certified on COFT for fear that their Officer Evaluation Rating (OER) will be hurt.

Quality I/Os

Again, the quality of COFT training is largely determined by the I/Os. For an I/O to be good, he must fully understand the M1 fire control system and be able to demonstrate the skills that he is trying to train. The I/O must also be able to use the performance feedback provided by the COFT and add to that what he has learned from his experiences in Armor and from training on

COFT. For example, nowhere in the I/O's training materials does it say that the I/O has to explain scanning techniques, coach the TC on his fire commands, or tell the gunner to dump his lead after lasing to a stationary engagement. Some I/Os do not train these procedures because they themselves are not proficient in the skills they are trying to train. When I/Os lack proper armor knowledge and experience, it is particularly difficult for them to train experienced armor crews. This can be a problem in units where the U-COFT I/Os have ranks as low as Specialists. Not only do those I/Os lack tank gunnery experience, but they have little credibility when it comes to providing feedback to experienced tankers with higher ranks.

In the field you get some good I/Os who are dedicated and do their job very well. Unfortunately, commanders sometimes have them train 14 hours a day. Armor training doctrine states that COFT training efficiency starts to drop off after two hours, because it is a stressful training environment. It is sometimes forgotten that COFT training is stressful for the I/O as well. For an I/O to be doing his job correctly, he should be simultaneously scanning three monitors, running a tape recorder, taking notes, acting as a crew member, and loading and reloading ammunition. It is very difficult to do all of these things for long period of times and remain motivated. Also, like crew gunnery skills, the gunnery skills of the I/O degrade over time. If the I/O does not train to keep his gunnery proficiency honed, the quality of training will likewise degrade.

In the units, NCOs are often detailed to be COFT I/Os. Their job primarily becomes powering up the machines and then training for long periods of time. Often no one checks to see if the I/Os are doing a good job. It is likely that the overall quality of COFT training would be enhanced, if the training were monitored more closely by the chain of command.

Performance Feedback

While the COFT does provide automated feedback capabilities, it is the responsibility of the I/O to tell the gunners and Tcs what they are doing right and wrong. Especially for inexperienced gunners and TCs, the more feedback that the I/O gives, the greater and faster the development of skills. The COFT gives some feedback on its own after each engagement in that the crew sees whether or not they killed the target. It is not enough for the I/O to tell a new gunner that he killed seven out of ten targets. It is the I/O's job to explain why he is missing the targets and what he should do to correct the problems.

Anytime a crew fails a scored area twice in a row, the I/O should (by doctrine) stop the exercise and explain what the crew is doing wrong and offer a suggestion as to how they could do better. Furthermore, the I/Os are trained that anytime they see a gross mistake, they should stop the crew immediately and tell them what they are doing wrong. For example, the I/O should tell the crew that if they are scanning completely out of sector and also tell them that it is the TC's responsibility to keep the gunner in sector. It was also suggested that the more the chain of command monitors the training, the more that quality feedback is given.

One I/O said that the COFT should be used more as a trainer and less as a tester. By that he meant that more feedback should be given after specific engagements, rather than waiting until the end of the exercise. If the I/O, for example, waits until the end of a ten engagement exercise to give feedback on engagement two, the crew may have trouble remembering that engagement or why they did what they did. In general, the sooner feedback is the given, the more effective it is.

Proper Crew Motivation

In addition to providing technical training, it is the I/O's responsibility to help the soldier maintain the proper level of motivation or arousal. The I/O should make sure that the crew's motivation is neither too high nor too low. Initial tracking problems, for example, are sometimes caused by the gunner being too excited or by the fact that he is putting too much pressure on himself. Training, as well as performance, is most effective, when a soldier is alert but relaxed. Similarly, the gunner's grip on the power control handles should be firm but relaxed. One of the ways the I/O can help the gunner to relax is to not put so much emphasis on passing the early exercises. Whether a crew gets a GO or NO GO on the early exercises does not matter so much in the long run. What is important is that the gunner learns the proper fundamentals of gunnery. The I/O should tell the gunner to do his best and not to worry about whether or not he gets a GO. This helps the gunner to relax and will lead to better performance in the long run.

Conversely, some I/Os are overly enthusiastic and promote an attitude of overkill. This tends to make the trainee more nervous and causes him to rush. This can be detrimental in the field where calmness and confidence are critical. I/Os should try to promote a comfortable training atmosphere and train in a way which inspires self-confidence.

COFT Training in OSUT

Gunnery training in OSUT was said to be important, even though it may be a couple of years before the trainee becomes a gunner. The OSUT I-COFT training familiarizes the trainee with the tank. Also, it motivates the young tanker by giving a him a taste of what being a gunner is like. The OSUT I-COFT training is also important in the case of combat when crew members will be killed and crews will be reconstituted. Some relatively inexperienced tankers will quickly be moved into the gunner's seat. If the new gunner has had COFT training, he probably will be able to be trained up more quickly and the TC will have more confidence in him.

Advanced Matrix

The Armor School is currently developing an "Advanced Matrix" for the COFT which is designed to replace the existing crew and TC training matrices. A primary goal of the advanced matrix is to provide more realistic tank gunnery training on COFT by including more realistic tank gunnery scenarios. Compared to the existing matrix, the advanced matrix is designed to develop the basic tank gunnery skills necessary for live-fire qualification more rapidly. The advanced matrix will be sent to all units and will be placed on

the same disk as the old matrix. The old matrix will still, however, be available for remedial training.

Exercise Groups

The advanced matrix will contain four groups of exercises. Group I will include all basic gunnery engagements, including all conditions required in Tank Table VIII. This consists of offensive and defensive engagements, single and multiple targets, and simultaneous engagements. Group I exercises are predominantly full-up engagements with the addition of some basic GAS battlesight engagements. The Group I gate test will be a U-COFT Tank Table VIII which will become the live-fire prerequisite. Group II exercises will train basic combat gunnery skills and will include normal and degraded mode gunnery engagements. Group II will include exercises similar to those in the existing matrix, in that fire control malfunctions will be announced at the beginning of an exercise.

Group III will provide advanced combat gunnery exercises with 2-4 targets per engagement. These engagements will require the use of multiple weapons and ammunition. Crews will be informed prior to an exercise that a particular fire control malfunction will occur at some point during the exercise, e.g., there will be stabilization failure. It will be the crew's responsibility to recognize the malfunction when it occurs and to take the appropriate actions. Group IV will require the crew to fight in an unpredictable combat environment, which will include unannounced fire control malfunctions. The condition of the tank will be determined, in part, by the performance of the crew, in that fire control malfunctions will occur when and if the tank is hit.

More Realistic Target Arrays

One of the major changes in the advanced matrix involves the target arrays and their effects on target acquisition training. The COFT currently does not do a very good job of training target acquisition because the crew is told the number (one or two) and kind of targets (stationary or moving) that will be engaged. In the advanced matrix, the number of targets will vary. One engagement might have one target while the next engagement could have up to four targets. The advanced matrix will also have random target generation capabilities such that target locations will be unpredictable, even on multiple replications of the same exercise. As a result, crews will no longer be able to learn where the targets are going to appear. The targets in the advanced matrix will also have kill zones that more closely represent actual threat conditions. No longer will a hit on the fender result in a catastrophic kill.

The advanced matrix will also present more realistic target scenarios. An advanced matrix scenario, for example, might begin by presenting three moving BMPs in the left sector. After the gunner starts to engage the first BMP, a T-72 might emerge in the right sector. The TC would have to then have to terminate the BMP engagements and move the gunner over to the new most dangerous target, the T-72. The TC would have to continue to monitor the

location of the BMPs and later slew the gunner back to the BMPs after the T-72 engagement was completed.

Supplementary Firing Positions

The advanced matrix will also have supplementary firing positions on the defense, whereby the TC can direct the driver to move back and then to either the right or left. The scoring will be such that points will be deducted if the crew backs up or moves when they should have stayed up to engage. The crew will also be limited to the amount and type of ammunition in the ready rack. Scoring will be based on target destruction, rather than on whether a particular weapon or ammunition type was used for a particular target. The crew may, for example, kill BMPs early in the exercise using SABOT rounds and receive full credit. Towards the end of the exercise, however, they could be faced with T-72s for which they would have no armor defeating ammunition left.

Prep-to-Fire Checks

Each advanced matrix training session will begin with a preparation-to-fire exercise, in which the crew must boresight and enter data in the ballistic computer. The fire control system status at the end of the prep-to-fire exercise will be passed on into the exercise session. If the crew fails to boresight correctly, or if later the boresight is knocked out during an exercise, the crew will likely miss the targets. The status of the boresight, as well as other system information, will be displayed on the I/O's monitor, so that the I/O will know the status of the system and can train how to remedy particular situations.

Advantages of Live-Fire Training

The last set of questions asked the I/Os to discuss the specific value of live-fire training, differences between live-fire training and COFT, and the relationship between live-fire and COFT training. In general, the I/Os said that COFT and live-fire were an ideal training mix. They said that most all tank gunnery skills could be trained and sustained on COFT, but that the crews needed to experience the realism of live-fire to hone their skills and to gain confidence in their abilities.

Live-fire exercises allow the gunner and crew to develop and maintain a physical familiarization of what it is like to fire the main gun on an actual tank. Live-fire trains the crew how to engage targets with the actual feel of the tank hydraulics, and how to deal with recoil, platform rock, and muzzle obscuration. Also, while the COFT trains offensive tank gunnery techniques, the COFT does not actually move. Live-fire, therefore, trains the crew how to fire on the move with the true dynamics of motion. Gaining the feel of what it is like to fire the tank is particularly important for novice gunners. Several I/Os told of how novice gunners with COFT experience were afraid the first time that they had to fire the main gun. The I/Os went on to suggest that live-fire was the only way of training the new gunners to remain calm. It was, however, generally agreed that once the gunners became familiar with firing, it was not something that they forgot.

Becoming familiar with the dynamics of actual live-fire allows the crew to become more relaxed. Shooting actual ammunition in the field and observing the resulting target destruction gives the gunner more confidence in the tank and his abilities. It is important for the gunner to know that he can do it for real, and that if he were to go to battle, that he is truly capable of destroying enemy targets. U.S. tankers need that confidence so that they will be able to succeed on the battlefield, even with a numerical disadvantage. Live-fire training teaches the soldier that the man and the machine can work together to engage and destroy targets.

Another advantage of live-fire training is that it trains coordination of the entire crew. By contrast, the COFT primarily trains only the TC and gunner. During live-fire, the loader learns to load while the driver learns tactical combat driving. Most important is that all four crew members learn to act as a single well-coordinated unit. Other simulators, such as the Precision Range Integrated Maneuver Exercise (PRIME), also train full crew coordination.

Unlike the training in simulators, live-fire exercises train crews to operate in conditions that are not so well-controlled. Training on the range presents a much different and more realistic environment than in the simulator. On the range, there is controlled chaos. The soldiers' adrenalin is flowing. Crews know they must continue to fight despite possible equipment malfunctions. Live-fire also gives the crew the opportunity to learn creative ways of accomplishing tasks. The TM, for example, states that there are two ways of firing the Cal .50 machine gun, manually or with power. The TC can, however, simply reach up and hit the butterfly with his hand or a stick. If the enemy is out there firing at you, a good crew will do anything to return fire. Live-fire creates the realistic training environment necessary for the full development of tank gunnery skills.

REFERENCES

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Graham, S.E., and Smith, T.L. (in preparation). Identifying tank gunnery skill requirements on the Institutional Conduct-of-Fire Trainer (I-COFT). (Draft ARI Research Report). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Appendix A.

Structured Interview to Identify Skill Requirements of M1 I-COFT Proficiency

Responses will be taped.

I. BACKGROUND

Consider the following sets of gunnery skills with example behaviors and tasks for each. Because this interview is focusing on the tank gunner, only the first three sets of skills will be discussed.

A. Target Acquisition Skills
- Search/scanning methods
- Detect target/signature/obstacle
- Identify target
- IFFN
- Nomenclature
- Classify multiple targets as most dangerous

B. Tracking skills
- Lay on center mass
- Make control lay
- Reengage
- Engage multiple target with main gun
- Track and engage subsequent targets
- Degraded mode tracking
- Apply appropriate lead in degraded mode

C. Procedural skills
- Set/Check switches
- Switch 3X/10X
- Lasing
- Evaluating range display
- Degraded mode procedures

Communication skills

Crew Coordination skills

Command and Control skills

Fire Distribution skills

II. The purpose of the first set of questions is to gather information on how the COFT can best be used to train tank gunner skills that lead to improved live-fire performance.

A. TARGET ACQUISITION SKILLS

1. What do you look for to see if the gunner is adequately demonstrating target acquisition skills? i.e., what behaviors demonstrate this skill or a skill deficiency.

2. How can you best train target acquisition skills on the COFT that transfer to live-fire performance?

a. What are other approaches that may work as well?

b. What COFT training approaches do not work?

3. What are the limitations of COFT for training target acquisition skills?

a. How can you work around these limitations?

4. What do the best gunners do to quickly and accurately acquire targets on the COFT?

a. Which elements of target acquisition best discriminate good and poor gunners?

b. How do you train high aptitude/experienced/good performers?

c. How do you train low aptitude/inexperienced/poor performers?

5. Are there other advanced COFT techniques that you train or performance tips that you give pertaining to target acquisition?

B. TRACKING SKILLS

1. What do you look for to see if the gunner is demonstrating good tracking skills? i.e., what behaviors demonstrate this skill or a skill deficiency.

2. How can you best train tracking skills on the COFT that will transfer to live-fire performance?

a. What are other approaches?

b. What approaches do not work?

3. What are the limitations of COFT for training tracking skills?

a. How can you work around these limitations?

4. What do the best gunners do to quickly and accurately track targets on the COFT?

a. Which elements of tracking best discriminates good and poor gunners?

b. How do you train high aptitude/good performers?

c. How do you train low aptitude/poor performers?

5. Are there other advanced COFT techniques that you train or performance tips that you give pertaining to tracking?

C. GUNNERY PROCEDURAL SKILLS

1. What do you look for to see if the gunner is adequately demonstrating gunnery procedural skills? i.e., what behaviors demonstrate this skill or a skill deficiency.

2. How can you best train procedural skills on the COFT that transfer to live-fire performance?

a. Which gunnery procedures can best be trained on the COFT and why?

b. Which gunnery procedures cannot be particularly well trained on the COFT and why?

3. What do the best gunners do to quickly and accurately perform gunnery procedures on the COFT?

a. Which gunnery procedures best discriminate high and low performers?

b. How do you train high aptitude/good performers?

c. How do you train low aptitude/poor performers?

4. Are there other advanced COFT techniques that you train or performance tips that you give pertaining to procedural skills?

III. Certain skills may be trained on the COFT that lead to better COFT performance, but these skills may not be related to live-fire performance. We will refer to these as COFT-specific skills. Describe any COFT-specific gunner skills for each of the skill areas.

A. Target acquisition skills

B. Tracking skills

C. Gunnery procedural skills

IV. Likewise, there may be some gunner skills required for good live-fire performance that are not trained on COFT. Describe any of these gunner skills for each of the areas.

A. Target acquisition skills

B. Tracking skills

C. Gunnery procedural skills

V. There may also be some skills which are trained on the COFT that lead to poorer live-fire performance. This is often referred to as negative transfer. Describe any of these gunner skills for each of the areas.

A. Target acquisition skills

B. Tracking skills

C. Gunnery procedural skills

VI. Lastly, describe those skills that are trained by live-fire that cannot be adequately trained otherwise. In other words, what specific value is there in live-fire training?